EUROPEAN ORGANISATION
FOR THE SAFETY OF AIR NAVIGATION

OVERALL ATM/CNS TARGET ARCHITECTURE

WP8.1 Define Methodologies for Validation within OATA

Validation Methodology Overview

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Abstract

This document gives an overview of the four different assessments methodologies to be applied on the Overall ATM/CNS Target Architecture (OATA) logical model. The assessments cover the following four areas: “Architecture Compliance with User Requirements”, “Architecture Structure”, “Architecture Compliance with Non-Functional Requirements” and “Architecture Tactics”.

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DOCUMENT APPROVAL

The following table identifies all management authorities who have successively approved the present issue of this document.

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DOCUMENT CHANGE RECORD

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1.0	3 May 2006	Updates after OATA pilot validation and IRB	all

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EXECUTIVE SUMMARY

The validation methodology addressed in this document is intended for the early lifecycle phases of the architectural developments of the Overall ATM/CNS Target Architecture (OATA) project.

The purpose of validation is to increase confidence in the architecture being developed, and to ensure that it meets Stakeholders' expectations and quality criteria.

This document gives an overview of the four different assessments methodologies to be applied on the Overall ATM/CNS Target Architecture logical model. The assessments cover the following four areas: "Architecture Compliance with User Requirements", "Architecture Structure", "Architecture Compliance with Non-Functional Requirements" and "Architecture Tactics".

An overview of each area of these assessment methodologies is described in this document and a reference is given where more details about the methodologies can be obtained.

1 INTRODUCTION

1.1 OATA Project Background

In the past, the European Air Traffic Management system has been built with no common Operational Concept or high-level architecture design, leading to the limited interoperability of the current systems. The Operational Improvements envisaged in the EUROCONTROL ATM2000+ Strategy, as well as the aims of the European Commission's Single European Sky initiative, can only be achieved with interoperable systems based on a common operational concept. To meet this requirement, the Overall ATM/CNS Target Architecture (OATA) project defines the high-level logical design of an integrated ATM "system of systems" across all ECAC States, towards which the present individual national systems will evolve.

The OATA Project provides guidance on moving from policies and strategy to implementation. While developing common ATM Concepts of Operation for the near future, it defines a number of logical building blocks for the required ATM/CNS functionality and provides the standardisation framework and guidelines needed for those building blocks to interoperate. The overall target architecture will address all the operational and technical issues of the gate-to-gate approach to air traffic management. OATA works in close cooperation with the SESAR project and the OATA logical architecture is the main input for the Logical Architecture work in SESAR. The OATA project also works closely with standardisation bodies such as EUROCAE and, as such, acts as an important link between industry partners to ensure standardised development. The final products of OATA, when made available, will be fully agreed and endorsed by all stakeholders, including Air Navigation Service Providers, Airport Authorities, Industry and Airspace Users, ensuring early buy-in and a smooth transition of existing systems towards the new, OATA-compliant system of systems.

1.2 OATA Logical Architecture

The Overall ATM/CNS Target Architecture represents the high level design of an integrated ATM system of systems across all ECAC States. It is important to highlight that the OATA Project aims to define *interfaces* of the different modules; that is the services provided and consumed by a module, and not the internal behaviour or algorithmic aspects of the module itself.

The Overall ATM/CNS Target Architecture is segmented as follows:

1. **ATM Operations**: This area provides direct support for the main actors of the system. The architecture reflects the organisational structure of ATM and covers En-Route and Approach ATC, Aerodrome ATC, Airport Operations, Airspace User Operations, Airspace Organisation and Management, and Air Traffic Flow and Capacity Management.
2. **ATM Shared elements**. ATM shared elements are common across one or more ATM/CNS domains, i.e. providing a common set of services accessing a common set of data no matter where it is instantiated. Examples are Flight and Aeronautical Information.
3. **ATM Support**: Communication, Navigation, Surveillance and Meteo.

The Overall ATM/CNS Target Architecture is split in modules and clusters. A module is defined as a group of collaborating classes supporting specific operational services and related to an ATM function while a cluster is defined as a logical grouping of modules.

For further details on the OATA logical architecture see deliveries from OATA work stream 4.

2 OATA VALIDATION

The validation methodology of the Overall ATM/CNS Target Architecture is intended for the early lifecycle phases of the architectural developments in the OATA project. The purpose is to increase confidence in the architecture being developed, and to ensure that it meets Stakeholders' expectations and quality criteria.

2.1 The approach for the OATA Validation

Figure 1 presents the elements considered for the development of the OATA logical architecture. This figure relates these elements, and indicates potential validation activities. The validation activities of the OATA logical architecture are addressed in this document. The figure also stresses the difference between validation and verification activities.

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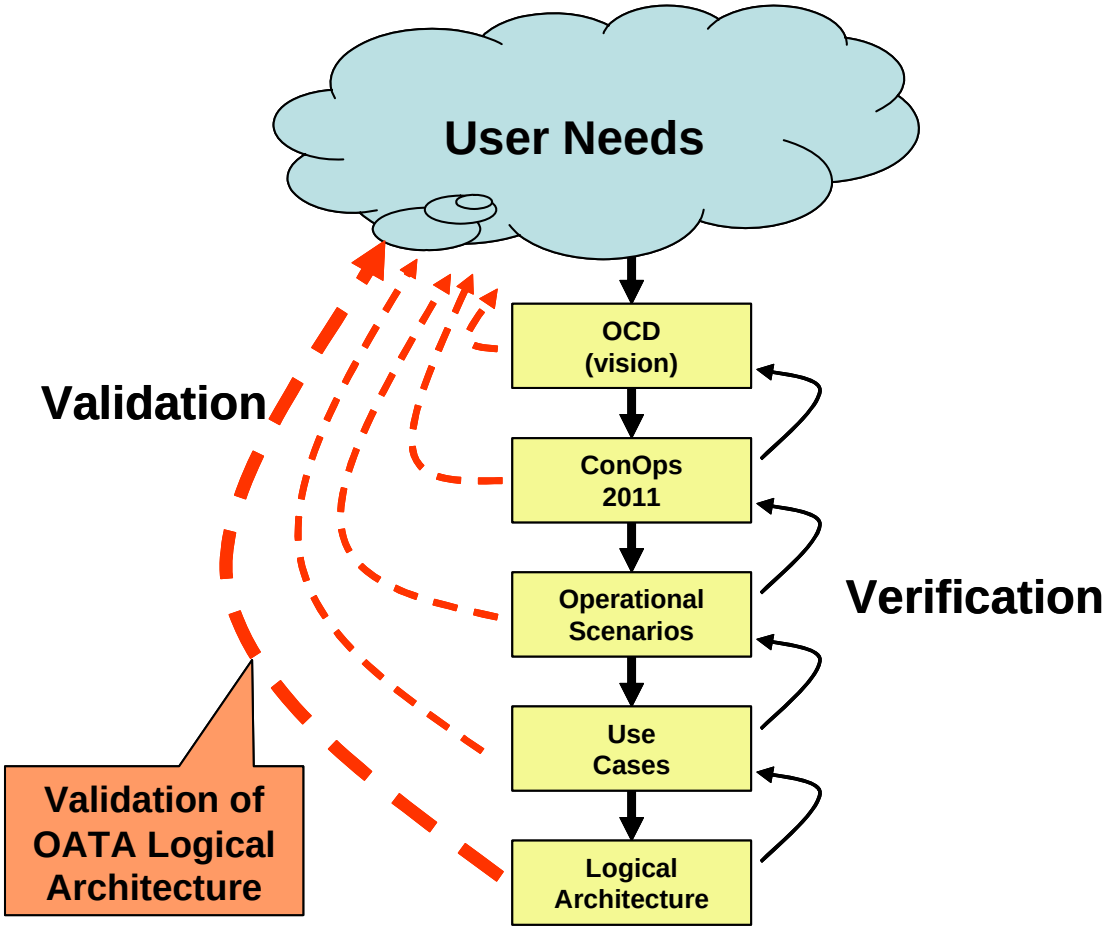

Figure 1: OATA Validation Framework

2.2 References

OATA Deliverable ID	Title
OATA-P2-D8.1.1-01	WP 8.1.1 “Define Methodology for Validation within OATA - Architecture Compliance Assessment Process”
OATA-P2-D8.1.2-01	WP 8.1.2 “Define Methodology for Validation within OATA - Architecture Structure Assessment Process”
OATA-P2-D8.1.3-01	WP 8.1.3 “Define Methodology for Validation within OATA - Architecture Non-functional Requirements Assessment Process”
OATA-P2-D8.1.4-01	WP 8.1.4 “Define Methodology for Validation within OATA - Architecture Tactics Assessment Process”

3 METHODOLOGY OVERVIEWS

3.1 Introduction

The validation of OATA logical architecture will be performed around four areas: “Architecture Compliance with User Requirements”, “Architecture Structure”, “Architecture Compliance with Non-Functional Requirements” and “Architecture Tactics”.

Figure 2 shows the four validation areas. Each of these areas has a specialised validation methodology. The methodologies describe the objectives of each area and what shall be validated in the architecture. Each methodology details also the required resources and a sequence of activities that the validation team shall execute. It is recommended that the selected subsets of the OATA logical architecture are validated in respect of these four validation areas. This will enhance the benefit of the validation of the OATA logical architecture.

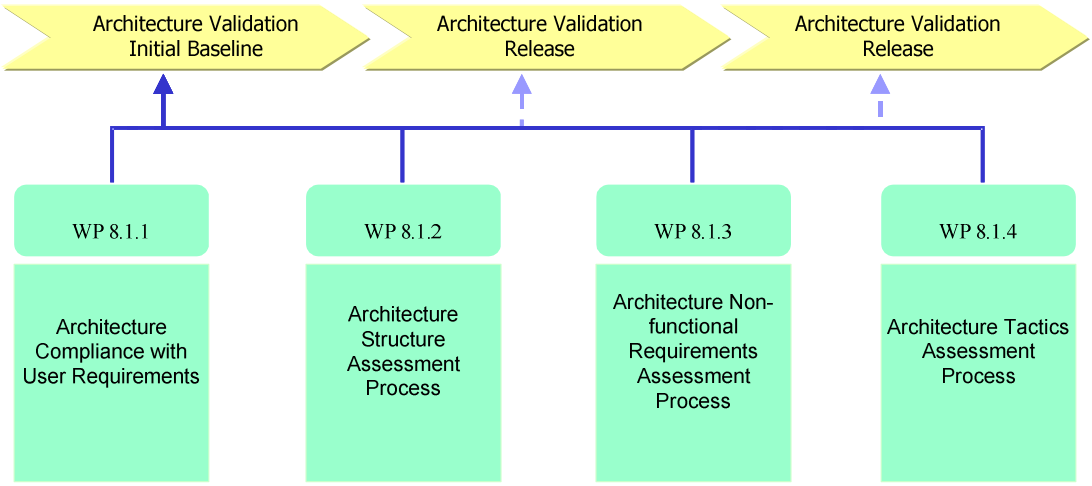

Figure 2: Summary of the Architecture Validation Process

It should be noted that even though a possible timeline is indicated, the activities can be performed in any order.

A short overview of the methodologies is given in the following sections.

3.2 Architecture Compliance with User Requirements (WP8.1.1)

The aim of the validation of the compliance with User Requirements is to perform a comparison between User Expectations within the scope of the goals, knowledge and information contained in the OCD, and the OATA logical architecture. The architecture will be evaluated against the Validation Participant’s understanding of the OCD and their observations will be used to challenge or question the OATA architecture OCD implementation. The methodology is centred on the Stakeholder, and is oriented towards the provision of an increased understanding of the system, and on the early detection of potential sources of inconsistencies and problems. The methodology is briefly summarised hereafter.

OCD User Needs are the origin of the OCD Vision and the OATA architecture is derived in a number of intermediate steps from the OCD Vision. To validate the correctness and completeness of the OATA logical architecture and to ensure that no translation errors are made in the intermediate steps, it is needed to validate that User Needs are adequately represented in the architecture. This process can be lengthy and effort consuming. Therefore, validation effort must be optimised and focused on the essential User Needs / Expectations.

The Stakeholder will define Validation Aims, which are based on their User Needs, and are prioritised. The Validation Aim will be the starting point to identify architecture execution paths that use several modules of the architecture. These paths are called Operational Threads and are used to validate that a User Need is met.

Operational Threads are thus derived from the User Needs / Expectations, and are used to validate a subset of the User Needs. Only the User Needs also identified in the OCD are the subject of validation within OATA. The subset will be selected by the users based on their expert opinion on what is most beneficial / important in 2011.

For a detailed description on the Architecture Compliance with User Requirements methodology see reference [OATA-P2-D8.1.1-01].

3.3 Architecture Structure Assessment (WP8.1.2)

Architecture is a formal description that encompasses a set of design decisions that affect the system behaviour and performance. A validation of the quality of the OATA logical architectural structure is required to increase the confidence in the architecture being developed, and to ensure that it meets Stakeholders' expectations and quality criteria.

The validation of the structure of an architecture focuses on assessing different quality characteristics. The validation is guided by the definition of Validation Aims. A Validation Aim is a high-level expectation of the logical architecture and indicates the quality characteristics to be further investigated and assessed in a validation cycle.

The selected Quality Model for the validation of the OATA architecture structure is ISO/IEC 9126. This Quality Model represents an international effort to collect the ideas and experiences related to the quality of a software system over the last decades.

The ISO/IEC 9126 categorises quality into six quality characteristics to be used for the assessment of quality. One key aspect of the characteristics is that they are reasonably independent and cover a wide range of quality aspects. This validation methodology focuses on the quality characteristics of maintainability and understandability. These quality characteristics are further subdivided into sub characteristics, which are influenced by different quality attributes. A quality attribute is a measurable property that can be quantified by one or several metrics. A metric is a definition of measurement method of a certain property in Architecture. Included in this methodology is a set of suitable metrics for the assessment of the OATA logical architecture.

The analysis and conclusions of the validation results and the recommendations of the validation team (documented in a validation report) can be used for further refinement of the OATA logical architecture.

For a detailed description on the methodology see reference [OATA-P2-D8.1.2-01].

3.4 Non-Functional Requirements Assessment (WP8.1.3)

The OATA logical architecture addresses the definition of high-level services to be provided by future systems in order to achieve the User Requirements. The non-functional requirements (NFRs) describe the required quality of services, for instance timeliness, capacity or other quality characteristics.

A validation of non-functional requirements is important in order to increase the confidence in the OATA logical architecture to handle the non-functional requirements defined in OATA WP 5.1. The main objective for WP 8.1.3 is defined as follows:

Qualitative validation on the OATA logical architecture regarding mapping and correctness of non-functional requirements:

- Validation of the correctness of the NFR mapping to the OATA logical architecture.

- Validation of the correctness of the NFRs in the context of Operational Threads (as defined in section 3.2).

The validation of the OATA logical architecture and it's compliance with the defined non-functional requirements will result in an assessment of the consistency and completeness of the quality of service specification of required services and recommendations of improvements of the non-functional requirements.

For a detailed description of the Non-Functional Requirements assessment methodology see reference [OATA-P2-D8.1.3-01].

3.5 Architecture Tactics Assessment (WP8.1.4)

The purpose of this methodology is to identify, understand and assess implicit and explicit assumptions, which were made during the development of the OATA logical architecture. The methodology will try to make these assumptions explicit by identifying tactics and patterns that imply important properties regarding the development of an architecture: maintainability, general interoperability and system interoperability.

Tactics and patterns in the architecture are mainly used for two reasons: to follow established practice (or common sense), and to simplify a difficult analysis/design problem by re-applying the solutions of comparable problems. In most situations, tactics and patterns are needed to ensure a correct and coherent architecture.

Assumptions will be identified through architecture inspections performed by a team composed of both OATA architecture experts and architecture validation experts. Identified assumptions will be analysed and assessed and finally, the validation team will propose recommendations how OATA logical architecture could be improved.

For a detailed description on the Architecture Tactics assessment methodology see reference [OATA-P2-D8.1.4-01].